

**WHAT IS CLAIMED IS:**

1. An apparatus for embedding watermark information in image data compressed by orthogonal transformation, quantization, run length encoding and variable length  
5 encoding, comprising:

a variable length decoding means for extracting a codeword and an additional bit or bits corresponding to the codeword from the compressed image data based on a code table;

10 an embedding means for embedding watermark information in a prescribed bit of the additional bits extracted by the variable length decoding means; and

a connecting means for connecting the additional bits having the watermark information embedded therein by the  
15 embedding means with the codeword extracted by the variable length decoding means to produce a variable length code.

2. The apparatus according to claim 1, further comprising a domain determining means for determining whether  
20 the codeword extracted by the variable length decoding means is included in a first frequency domain or not, wherein the embedding means embeds the watermark information in the prescribed bit of the additional bits corresponding to the codeword determined as being included in the first frequency  
25 domain by the domain determining means.

3. The apparatus according to claim 1, further comprising a bit length determining means for determining whether the additional bits extracted by the variable length  
5 decoding means have a prescribed bit length or not, wherein the embedding means embeds the watermark information in the prescribed bit of the additional bits determined as having the prescribed bit length by the bit length determining means.

10 4. The apparatus according to claim 1, further comprising a color component determining means for determining whether a color component of the codeword extracted by the variable length decoding means is a prescribed color component or not, wherein the embedding  
15 means embeds the watermark information in the prescribed bit of the additional bits corresponding to the codeword determined as being the prescribed color component by the color component determining means.

20 5. The apparatus according to claim 1, wherein the variable length decoding means further extracts a codeword from the compressed image data based on the code table as preprocessing of the extracting operation, the apparatus further comprising a codeword counter for counting the number  
25 of codewords extracted by the variable length decoding means

as the preprocessing.

6. The apparatus according to claim 5, further comprising a bit designating means for designating the prescribed bit for embedding the watermark information, based on the number of codewords counted by the codeword counter.

7. The apparatus according to claim 2, wherein the variable length decoding means further extracts a codeword from the compressed image data based on the code table as preprocessing of the extracting operation, and the domain determining means further determines whether the codeword extracted by the variable length decoding means in the preprocessing is included in a second frequency domain or not, the apparatus further comprising a domain codeword counter for counting the number of codewords determined as being included in the second frequency domain by the domain determining means.

8. The apparatus according to claim 7, further comprising a frequency domain designating means for designating the first frequency domain based on the number of codewords counted by the domain codeword counter.

9. The apparatus according to claim 1, further

comprising: a means for producing header information that indicates which of the additional bits has the watermark information embedded therein; and a means for multiplexing the header information produced by the header information producing means with the variable length code produced by the connecting means.

10. The apparatus according to claim 2, further comprising: a means for producing header information that indicates a frequency domain of the additional bit having the watermark information embedded therein by the embedding means; and a means for multiplexing the header information produced by the header information producing means with the variable length code produced by the connecting means.

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11. An apparatus for retrieving watermark information from compressed image data having watermark information embedded therein by the apparatus according to claim 9, comprising:

20 an analyzing means for recognizing the prescribed bit having the watermark information embedded therein, based on the header information;

a variable length decoding means for extracting an additional bit or bits from the compressed image data based on a code table; and

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a means for retrieving data of the prescribed bit recognized by the analyzing means from the additional bits extracted by the variable length decoding means.

5        12. An apparatus for retrieving watermark information from compressed image data having watermark information embedded therein by the apparatus according to claim 10, comprising:

10        an analyzing means for recognizing a frequency domain of an additional bit having the watermark information embedded therein, based on the header information;

15        a variable length decoding means for extracting an additional bit or bits from the compressed image data based on a code table; and

20        a means for retrieving data of the prescribed bit of the additional bits extracted by the variable length decoding means when the extracted additional bits are included in the frequency domain recognized by the analyzing means.

25        13. A method for embedding watermark information in image data compressed by orthogonal transformation, quantization, run length encoding and variable length encoding, comprising the steps of:

      extracting a codeword and an additional bit or bits corresponding to the codeword from the compressed image data

based on a code table;

embedding watermark information in a prescribed bit of the additional bits extracted by the extracting step; and

connecting the additional bits having the watermark information embedded therein by the embedding step with the codeword extracted by the extracting step to produce a variable length code.

14. The method according to claim 13, wherein the compressed image data having the watermark information embedded therein by the method according to claim 13 is restored, and the extracting step, the embedding step and the connecting step are conducted again with a reduced number of prescribed bits according to a degree of degradation in quality of the restored image.

15. The method according to claim 13, wherein when part of the watermark information to be embedded fails to be embedded, the extracting step, the embedding step and the connecting step are conducted again with an increased number of prescribed bits.

16. The method according to claim 13, further comprising the step of determining whether the codeword extracted by the extracting step is included in the first frequency domain or

not, wherein in the embedding step, the watermark information is embedded in the prescribed bit of the additional bits corresponding to the codeword determined as being included in the first frequency domain by the determining step.

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17. The method according to claim 16, wherein the compressed image data having the watermark information embedded therein by the method according to claim 16 is restored, and the extracting step, the embedding step and the  
10 connecting step are conducted again with a reduced first frequency domain according to a degree of degradation in quality of the restored image.

18. The method according to claim 16, wherein when part  
15 of the watermark information to be embedded fails to be embedded, the extracting step, the embedding step and the connecting step are conducted again with an increased first frequency domain.

20 19. The method according to claim 13, further comprising the step of determining whether the additional bits extracted by the extracting step have a prescribed bit length or not, wherein in the embedding step, the watermark information is embedded in the prescribed bit of the additional bits  
25 determined as having the prescribed bit length by the

determining step.

20. The method according to claim 19, wherein the compressed image data having the watermark information  
5 embedded therein by the method according to claim 19 is restored, and the extracting step, the embedding step and the connecting step are conducted again with a reduced range of the prescribed bit length according to a degree of degradation in quality of the restored image.

10 21. The method according to claim 19, wherein when part of the watermark information to be embedded fails to be embedded, the extracting step, the embedding step and the connecting step are conducted again with an increased range  
15 of the prescribed bit length.

22. The method according to claim 13, further comprising the step of determining whether a color component of the codeword extracted by the extracting step is a prescribed  
20 color component or not, wherein in the embedding step, the watermark information is embedded in the prescribed bit of the additional bits corresponding to the codeword determined as being the prescribed color component by the determining step.



23. The method according to claim 22, wherein the compressed image data having the watermark information embedded therein by the method according to claim 22 is restored, and the extracting step, the embedding step and the connecting step are conducted again with a different prescribed color component according to a degree of degradation in quality of the restored image.

24. The method according to claim 13, wherein preprocessing of the extracting step includes the steps of extracting a codeword from the compressed image data based on the code table, and counting the number of extracted codewords.

25. The method according to claim 24, wherein the preprocessing further includes the step of designating the prescribed bit for embedding the watermark information, based on the number of codewords counted by the counting step.

26. The method according to claim 16, wherein preprocessing of the extracting step includes the steps of extracting a codeword from the compressed image data based on the code table, determining whether the extracted codeword is included in a second frequency domain or not, and counting the number of codewords determined as being included in the

second frequency domain.

27. The method according to claim 26, wherein the preprocessing further includes the step of designating the  
5 first frequency domain based on the number of codewords counted by the counting step.

28. The method according to claim 13, further comprising the step of multiplexing header information with the variable  
10 length code produced by the connecting step, the header information indicating which of the additional bits has the watermark information embedded therein.

29. The method according to claim 16, further comprising  
15 the step of multiplexing header information with the variable length code produced by the connecting step, the header information indicating a frequency domain of the additional bit having the watermark information embedded therein by the embedding step.

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30. A method for retrieving watermark information from compressed image data having watermark information embedded therein by the method according to claim 28, comprising the steps of:

25 recognizing the prescribed bit having the watermark

information embedded therein, based on the header information;

extracting an additional bit or bits from the compressed image data based on a code table; and

5 retrieving data of the prescribed bit recognized by the recognizing step from the additional bits extracted by the extracting step.

31. A method for retrieving watermark information from  
10 compressed image data having watermark information embedded therein by the method according to claim 29, comprising the steps of:

recognizing a frequency domain of an additional bit having the watermark information embedded therein, based on  
15 the header information;

extracting an additional bit or bits from the compressed image data based on a code table; and

retrieving data of the prescribed bit of the additional bits extracted by the extracting step when the extracted  
20 additional bits are included in the frequency domain recognized by the recognizing step.